REMARKS

I. Status of the Claims

Claims 1 –5 and 7-32 are currently pending.

Claim 6 has been cancelled.

Independent claim 1 has been amended for stylistic purposes, and to more clearly define the invention. Specifically, independent claim 1 has been amended to more clearly indicate that a functionalizing agent is added to the solution of dispersed carbon nanotubes. Claim 1 has also been amended to more clearly indicate that the functionalizing comprises covalently attaching the added functionalizing agent to the sidewalls of the dispersed carbon nanotubes. Support for these amendments can be found at least in FIGS. 1 and 3 and Paragraphs 35, 55-56, 60 and 67 of the Application.

Independent claim 1 has also been amended to indicate that the claimed acid solvent is "selected from the group consisting of a superacid and an oxoacid further comprising a persulfate species." Support for this amendment can be found at least in cancelled claim 6, FIG. 11, and Paragraphs 27, 52, and 66-67 of the Application.

Claims 16 and 27 have been amended for stylistic purposes, and to correct minor typographical errors.

Applicants hereby address the Examiner's remarks in the order that they appeared in the Office Action. In responding to this Office Action, Applicants also incorporate by reference the arguments made in the Reply filed on July 9, 2010.

II. Amendments to the Specification

Paragraph 2 of the Specification was amended for stylistic purposes. The amendments do not add any new matter.

III. Interview Summary

In response to the Office Action, Applicants held an interview by telephone on January 31, 2011 with Examiner Brittany M. Martinez and Supervisory Examiner Stanley Silverman (hereinafter "Interview"). Applicants' representative, Farhang Amini, participated in the Interview. Dr. James M. Tour, the primary inventor of the Application, also participated in the Interview.

During the Interview, Applicants pointed out that the combination of the prior art references that were cited in the Office Action does not teach or suggest the invention, as currently claimed. In particular, Applicants indicated that the combination of the cited references at least does not teach or suggest the claimed methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in a superacid (or an oxoacid with a persulfate species) through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution.

During the Interview, Applicants also pointed out that the aforementioned distinctions between the claimed invention and the prior art references were not obvious to a person of ordinary skill in the art at the time of the invention. Specifically, Applicants indicated that the claimed methods of functionalizing carbon nanotubes provided at least the following advantages that were absent from the prior art references: (1) a one-step method of carbon nanotube functionalization that can be (2) easily scaled up to (3) provide optimally functionalized carbon nanotubes in an (4) industrially acceptable manner (4) without the need to utilize additional steps (e.g., fluorination, sonication; centrifugation; and/or surfactant wrapping).

Applicants also indicated that the dispersion of carbon nanotubes in superacids (or oxoacids with persulfate species) during functionalization resulted in more effective functionalization. Specifically, Applicants indicated that more effective functionalization occurs because superacids (or oxoacids with persulfate species) surround carbon nanotubes with a double layer of protons and counterions. This in turn results in the substantial exposure of carbon nanotube sidewalls to the added functionalizing agents.

In contrast, Applicants pointed out that the dispersion of carbon nanotubes in non-superacids during a functionalization step would not provide the same results as the methods of the claimed invention. In particular, Applicants indicated that the dispersion of carbon

nanotubes in non-superacids still results in the formation of carbon nanotube bundles and aggregates that interfere with effective sidewall functionalization.

As understood by Applicants, the Examiners indicated that they will consider the allowability of the rejected claims in the Office Action if Applicants would file this Request for Continued Examination under 37 C.F.R. §1.114. Applicants thank the Examiners for devoting their time to discuss this case. Applicants hereby address the Examiner's remarks in the order that they appeared in the Office Action.

IV. Objections to the Drawings

In the Office Action, the Examiner objected to FIGS. 6-7, 9a and 10 for allegedly "being unclear and of insufficient quality for reprint in a patent publication." Office Action, pages 2-3. In response, Applicants refer to Replacement Sheets 5/11, 6/11, 8/11 and 9/11. The Replacement Sheets provide updated versions of FIGS. 6-7, 9a and 10 that are of clear and sufficient quality for reprint in a patent publication. Furthermore, the Replacement Sheets comply with 37 C.F.R. §1.121(d). Accordingly, Applicants respectfully request the withdrawal of the aforementioned objections.

V. 35 U.S.C. §103(a) Rejection of Claims 1-2, 4-5, 7-8, 10, 12, 15 and 30 over Cooper

In the Office Action, the Examiner rejected claims 1-2, 4-5, 7-8, 10-12, 15 and 30 as allegedly being obvious over U.S. Pat. App. Pub. No. 2007/0084797 to Cooper et al. (hereinafter "Cooper"). Applicants respectfully traverse these rejections because Cooper does not teach or suggest each and every limitation of the rejected claims.

For instance, Cooper does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1. In fact, Applicants are unaware of any disclosure in Cooper that satisfies the aforementioned claim limitation. This is not surprising because any acid treatment of carbon nanotubes in Cooper constitutes acid washes that occur separately and independently of any functionalization steps involving the covalent attachment of added functionalizing agents. *See, e.g.,* Paragraph 117 (indicating that "it is desired to ***wash*** the carbon nanotubes with a strong oxidizing agent such as ***acids*** and/or peroxides or combinations thereof

before forming a nanostructured [i.e., functionalized] material.") (emphasis and bracketed text added).

Moreover, Cooper does not teach or suggest the dispersion of carbon nanotubes in an acid solvent, as currently defined in claim 1. In particular, claim 1 now requires an acid solvent to be "selected from the group consisting of a superacid and an oxoacid further comprising a persulfate species." Yet, Cooper remains silent on the use of any superacids. Furthermore, and as the Examiner admits, Cooper does not teach or suggest the use of oxoacids that further comprise a persulfate species. *See, e.g.,* Office Action, pages 5-6.

Dependent claims 2, 4-5, 7-8, 10, 12, 15 and 30 pertain to different variations of independent claim 1. Therefore, those claims are also not obvious over Cooper for at least the aforementioned reasons that independent claim 1 is not obvious over Cooper. Applicants also traverse the aforementioned rejections for the reasons set forth in the Reply filed on July 9, 2010.

In the Office Action, the Examiner alleges that "if the liquid of Cooper is an acid such as sulfuric or nitric acid, one of ordinary skill in the art would expect the carbon nanotubes to have substantially exposed sidewalls and the functionalization to comprise covalently attaching functional groups to the substantially exposed sidewalls to form sidewall functionalized carbon nanotubes, to no less an extent than that of claim 1." Office Action, page 4. Applicants respectfully submit that this conclusory statement does not establish a *prima facie* case of obviousness, especially in view of the aforementioned defects in Cooper (i.e., failure to teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution.).

Applicants further submit that the dispersion of carbon nanotubes in non-superacids, such as non-fuming sulfuric acid and nitric acid, does not result in the substantial exposure of carbon nanotube sidewalls. Rather, as discussed in detail during the Interview, the dispersion of carbon nanotubes in non-superacids still results in the formation of carbon nanotube bundles and aggregates that interfere with effective functionalization. In contrast, since superacids surround carbon nanotubes with a double layer of protons and counterions, the sidewalls of carbon

nanotubes become more substantially exposed to added functionalizing agents. *See, e.g.,* Application, Paragraph 12. In turn, this leads to more effective functionalization.

In fact, the non-obviousness of the aforementioned claims in view of Cooper becomes more apparent when one considers Cooper and the present invention as a whole in accordance with the *Graham* factual inquiries. In particular, in developing the present invention, Applicants aimed to provide a one-step method of producing functionalized carbon nanotubes on a bulk scale without the need for multiple steps that could include fluorination, sonication, centrifugation, and surfactant wrapping. *See, e.g.*, Paragraph 53 (stating that "[f]luorine use, sonication and centrifugation are frowned upon heavily by industry due to the difficulty in scaling these processes" for producing "individualized nanotubes in the quantities needed for materials applications in bulk." *Also see* Paragraph 9 (stating that "a scaleable method of derivatizing carbon nanotubes under gentler conditions would be very beneficial, particularly if it is capable of providing individual nanotubes in their functionalized state--without the need for industrially-prohibitive or impractical procedures such as sonication, non-covalent polymer wrapping, and centrifugation.")

Accordingly, Applicants developed the claimed invention, where carbon nanotubes would be covalently functionalized in one step by added functionalizing agents while dispersed in an acid solvent. *See, e.g.,* Paragraphs 10-13 and amended claim 1. Furthermore, to obtain optimal functionalization of carbon nanotubes during acid dispersion, Applicants utilized superacids and oxoacids along with persulfate species. *See, e.g.,* Paragraphs 12, 44 and 52 (indicating that such strong acids provide carbon nanotubes with substantially exposed sidewalls for optimal functionalization).

Yet, the goals and approaches of Cooper were ancillary to the goals and approaches of the present invention. For instance, Cooper aimed to develop fluid purification methods by utilizing "defective carbon nanotubes." *See, e.g.,* Paragraph 25. Furthermore, any carbon nanotube functionalization steps disclosed in Cooper occurred after any acid treatment. *See, e.g.,* Paragraph 117. In addition, Cooper's functionalization methods involved multiple steps that included sonication and centrifugation. *See, e.g.,* Paragraphs 174-176 and 203-204.

VI. 35 U.S.C. §103(a) Rejection of Claim 6 over Cooper in View of Niu

The Examiner rejected dependent claim 6 as allegedly being obvious over Cooper in view of U.S. Pat. No. 7,070,753 to Niu et al. (hereinafter "Niu"). Office Action, pages 5-6. In particular, the Examiner has alleged that, while "Cooper does not disclose the acid solvent further comprising a persulfate species", this claim limitation is allegedly rendered obvious by Niu. *Id.* Applicants respectfully traverse this rejection because Niu does not cure the aforementioned defects in Cooper. In particular, Niu does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1 (now incorporating the limitations of cancelled claim 6).

The aforementioned defect in Niu is not surprising because Niu teaches away from the use of the claimed acid solvents (i.e., oxoacids comprising persulfate species and superacids). *See, e.g.,* Col. 5, ll. 1-2 (disclaiming the use of such acids because "[t]he use of ***strong acid*** such as nitric acid and sulfuric acid leads to corrosion problems.") (emphasis added). Instead, to avoid the use of strong acids, Niu primarily focuses on the oxidation of nanotubes with peroxygen compounds. *See, e.g.,* Title and Abstract. Applicants also traverse the aforementioned rejection for the reasons set forth in the Reply filed on July 9, 2010.

VII. 35 U.S.C. §103(a) Rejection of Claim 9 over Cooper in View of Dyke

The Examiner rejected dependent claim 9 as allegedly being obvious over Cooper in view of a 2003 JACS article by Dyke et al. entitled "Solvent-free functionalization of Carbon Nanotubes" (hereinafter "Dyke"). Office Action, page 6. Applicants respectfully traverse this rejection, at least because the combination of Dyke and Cooper does not teach or suggest each and every limitation of dependent claim 9.

For instance, the combination of Dyke and Cooper does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for dependent claim 9 (due to its dependency on claim 1). Applicants previously set forth the reasons why Cooper does not teach or suggest the above-mentioned claim limitation. Applicants further submit that Dyke does not cure the

aforementioned defects in Cooper, at least because Dyke does not teach or suggest the dispersion of carbon nanotubes in an acid solvent, as currently claimed.

In particular, due to its dependency from claim 1, claim 9 now requires an acid solvent to be "selected from the group consisting of a superacid and an oxoacid further comprising a persulfate species." However, Dyke does not teach or suggest the use of such acids. In fact, Dyke is silent on the use of any superacids. While Dyke mentions the use of oxoacids, such as H_2SO_4, Dyke is silent on the use of any persulfate species along with the oxoacid, as currently required for claim 1. *See, e.g.,* Scheme 1. In fact, the Examiner has admitted that this defect exists in Dyke. *See, e.g.,* Office Action, page 13 (paragraph 41).

Applicants respectfully submit the aforementioned defects in Dyke are not obvious, at least because the use of the claimed acid solvents help obtain better dispersed carbon nanotubes for functionalization. *See, e.g.,* Paragraphs 12, 44 and 52 of Application (indicating that the claimed acid solvents provide carbon nanotubes with substantially exposed sidewalls for optimal functionalization).

In fact, Figure 3 of Dyke affirms this significant distinction by showing nanotube bundles that are obtained by the methods disclosed in the reference. As set forth in the Interview, the formation of such carbon nanotube bundles and aggregates leads to non-optimal functionalization. Applicants also traverse the aforementioned rejection for the reasons set forth in the Reply filed on July 9, 2010.

VIII. 35 U.S.C. §103(a) Rejection of Claim 11 over Cooper in View of Csuzdi

The Examiner rejected dependent claim 11 as allegedly being obvious over Cooper in view of U.S. Pat. No. 6,600,036 to Csuzdi et al. (hereinafter "Csuzdi"). Office Action, page 6. Applicants respectfully traverse this rejection, at least because the combination of Cszudi and Cooper does not teach or suggest each and every limitation of dependent claim 11.

For instance, the combination of Csuzdi and Cooper does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for dependent claim 11 (due to its dependency on claim 1). Applicants previously set forth the reasons why Cooper does not teach or suggest the above-mentioned claim limitation. Applicants further submit that Csuzdi does not cure the aforementioned defect in Cooper, at least because Csuzdi does not teach or suggest any methods

for functionalizing carbon nanotubes. In fact, independent word searches for "nanotube", "functionalization" and "functionalize" in Cooper yielded no results. Applicants also traverse the aforementioned rejection for the reasons set forth in the Reply filed on July 9, 2010.

IX. 35 U.S.C. §103(a) Rejection of Claim 29 over Cooper in View of Khabashesku

The Examiner rejected dependent claim 29 as allegedly being obvious over Cooper in view of U.S. Pat. No. 7,125,533 to Khabashesku et al. (hereinafter "Khabashesku"). Office Action, page 7. Applicants respectfully traverse this rejection. For the reasons set forth previously, Cooper does not teach or suggest each and every limitation of dependent claim 29 (due to its dependency from independent claim 1). Furthermore, Khabashesku cannot cure any defects in Cooper because Khabashesku is not a prior art reference.

Khabashesku is not a prior art reference as a matter of law. *See* 35 U.S.C. § 103(c) and M.P.E.P. §706.02. In particular, Khabashesku is available as a prior art reference only under 35 U.S.C. § 102(e). In addition, Khabashesku and the present Application were, at the time the invention of the present Application was made, each commonly owned by, or under an obligation to assign to, William Marsh Rice University. Therefore, in accordance with the provisions of 35 U.S.C. § 103(c), the Examiner may not rely on Khabashesku to reject any of the claims of the present Application. *See* M.P.E.P. §706.02.

X. 35 U.S.C. §103(a) Rejection of Claims 1-5, 7 and 12-15 over Khabashesku in view of Davis

The Examiner rejected claims 1-5, 7 and 12-15 as allegedly being obvious over Khabashesku in view of a 2004 Macromolecules article by Davis et al. entitled "Phase Behavior and Rheology of SWNTs in Superacids." (hereinafter "Davis"). Office Action, pages 7-10. Applicants respectfully traverse this rejection. For the reasons set forth previously, Khabashesku is not a prior art reference. Furthermore, Davis does not teach or suggest each and every limitation of the rejected claims.

For instance, Davis does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for the rejected claims. In particular, Davis is entirely silent on any methods for functionalizing carbon nanotubes by added functionalizing agents. Furthermore, Applicants

are unaware of any teachings or suggestions in Davis that pertain to the functionalization of carbon nanotubes by added functionalizing agents.

The aforementioned defects in Davis are not surprising because Davis deviated from the goals and approaches of the present invention (as previously described). In particular, Davis merely focused on designing and optimizing a process for forming macroscopic objects for studying phase behavior and rheology of SWNTs. See, *e.g.*, Abstract. Thus, it is not clear how such phase behavior and rheology studies would have required the functionalization of carbon nanotubes dispersed in acid solvents by added functionalizing agents. In fact, as set forth in the Interview, the authors in Davis did not have any desire or motivation to functionalize carbon nanotubes.

XI. 35 U.S.C. §103(a) Rejection of Claim 6 over Khabashesku, Davis and Niu

The Examiner rejected claim 6 as allegedly being obvious over Khabashesku, in view of Davis, and in further view of Niu. Office Action, page 11. For the reasons set forth previously, Khabashesku is not a prior art reference. Furthermore, as set forth previously, Davis and Niu do not teach or suggest each and every limitation of claim 6, even when combined. For instance, the combination of Davis and Niu does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1 (incorporating the limitations of cancelled claim 6). *See* Sections VI and X of this Response.

XII. 35 U.S.C. §102(b) Rejection of Claims 1-2, 4-5, 7-10, 12 and 15 by Dyke

The Examiner rejected claims 1-2, 4-5, 7-10, 12 and 15 as allegedly being anticipated by Dyke. Office Action, pages 11-13. Applicants respectfully traverse this rejection because Dyke does not teach (or suggest) each and every limitation of the rejected claims.

For instance, Dyke does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for the rejected claims. In particular, and as the Examiner admits, Dyke does not teach or suggest methods of dispersing carbon nanotubes in an acid solvent that "is selected from the group consisting of a superacid and an oxoacid further comprising a persulfate species",

as currently required for the rejected claims. *See* Office Action, page 13 (paragraph 41). In fact, Dyke is silent on the use of any superacids. While Dyke mentions the use of oxoacids, such as H_2SO_4, Dyke still remains silent on the use of any persulfate species along with the oxoacid, as currently required for the rejected claims. *See, e.g.,* Scheme 1.

For at least the reasons set forth above, Dyke cannot anticipate the aforementioned rejected claims as a matter of law. Applicants also traverse the aforementioned rejections for the reasons set forth in the Reply filed on July 9, 2010.

XIII. 35 U.S.C. §103(a) Rejection of Claim 6 over Dyke in view of Niu

The Examiner rejected claim 6 as allegedly being obvious over Dyke in view of Niu. Office Action, page 13. Applicants respectfully traverse this rejection, at least because the combination of Niu and Dyke does not teach or suggest each and every limitation of claim 6.

For instance, even when combined, Dyke and Niu do not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1 (incorporating the limitations of cancelled claim 6). Rather, Niu teaches away from the use of the claimed acid solvents (i.e., oxoacids comprising persulfate species and superacids). *See* Section VI of Response. Instead, Niu focuses on the oxidation of nanotubes with peroxygen compounds. *Id.*

Furthermore, for the reasons set forth previously, Dyke does not cure the defects in Niu. *See* Sections VII and XII of Response. For instance, Dyke also does not teach or suggest the claimed acid solvents. *Id.*

XIV. 35 U.S.C. §103(a) Rejection of Claims 16-20, 22-28, 31 and 32 over Khabashesku in view of Davis and Cooper

The Examiner rejected claims 16-20, 22-28, 31 and 32 as allegedly being obvious over Khabashesku in view of Davis and in further view of Cooper. Office Action, pages 13-18. For the reasons set forth previously, Khabashesku is not a prior art reference. Furthermore, the combination of Davis and Cooper does not teach or suggest each and every limitation of the rejected claims. Therefore, Applicants respectfully traverse the aforementioned rejections.

For instance, the combination of Davis and Cooper does not teach or suggest any methods of forming "diazonium species" in a "superacid solvent" and "reacting…single-wall

carbon nanotubes with the diazonium species while" the carbon nanotubes are "dispersed in the superacid solvent to form functionalized single-wall carbon nanotubes", as required for independent claim 16 and the other rejected claims (due to their dependencies on independent claim 16). In fact, Applicants are unaware of any disclosure in Davis that pertains to any methods for functionalizing carbon nanotubes in superacid solvents by any functionalizing agents, including any formed diazonium species.

The aforementioned defects in Davis are not surprising because Davis deviated from the goals and approaches of the present invention (as previously described). In particular, Davis merely focused on designing and optimizing a process for forming macroscopic objects for studying phase behavior and rheology of SWNTs. See, *e.g.*, Abstract. Thus, it is not clear how such phase behavior and rheology studies would have required the functionalization of carbon nanotubes dispersed in superacid solvents by any added functionalizing agents, including formed diazonium species.

Moreover, for the reasons set forth in Section V of this Response, Cooper does not cure the aforementioned defects in Davis. In fact, Applicants are also unaware of any disclosure in Cooper that pertains to methods for functionalizing carbon nanotubes in superacid solvents by added functionalizing agents, including any formed diazonium species. This is not surprising because Cooper also remained silent on the use of any superacid solvents. Cooper also remained silent on any methods of forming diazonium species in a superacid solvent. Applicants also traverse the aforementioned rejections for the reasons set forth in the Reply filed on July 9, 2010.

In the Office Action, the Examiner alleges that "it is well-known in the art that diazonium species may be generated in situ by reaction of an aniline species with a nitrite species, and used in the functionalization of carbon nanotubes, as evidenced by Dyke." Office Action, page 16 (paragraph 48). Applicants respectfully submit that such a mere conclusory statement does not establish a *prima facie* case of obviousness as a matter of law. Applicants further submit that the aforementioned statement is silent on at least the following significant distinctions between the claimed invention and the prior art: the formation of "diazonium species" in a "superacid solvent" and "reacting…single-wall carbon nanotubes with the diazonium species while" the carbon nanotubes are "dispersed in the superacid solvent to form functionalized single-wall carbon nanotubes."

Applicants respectfully submit the aforementioned defect is not obvious, at least because the use of superacids help obtain better dispersed carbon nanotubes for functionalization. *See, e.g.,* Paragraphs 12, 44 and 52 of Application (indicating that superacids provide carbon nanotubes with substantially exposed sidewalls for optimal functionalization). In fact, Figure 3 of Dyke affirms this significant distinction by showing nanotube bundles that are obtained by the methods disclosed in the prior art reference.

XV. 35 U.S.C. §103(a) Rejection of Claim 21 over Khabashesku in view of Davis, Cooper, Dyke and Yu

The Examiner rejected dependent claim 21 as allegedly being obvious over Khabashesku in view of Davis, Cooper, Dyke and in further view of U.S. Pat. No. 6,399,202 to Yu et al. (hereinafter "Yu"). Office Action, pages 18-19. For the reasons set forth previously, Khabashesku is not a prior art reference. Furthermore, the combination of Davis, Cooper, Dyke and Yu does not teach or suggest each and every limitation of the rejected claims. Therefore, Applicants respectfully traverse the aforementioned rejection of dependent claim 21.

For instance, for the reasons set forth in Section XIV of this Response, the combination of Davis and Cooper does not teach or suggest any methods of forming "diazonium species" in a "superacid solvent" and "reacting…single-wall carbon nanotubes with the diazonium species while" the carbon nanotubes are "dispersed in the superacid solvent to form functionalized single-wall carbon nanotubes", as required for dependent claim 21 (due to its dependency on claim 16). Furthermore, Dyke does not cure the aforementioned defects in Davis and Cooper, at least because Dyke does not teach or suggest the use of any superacid solvents. *See* Sections VII and XII of Response.

Yu also fails to cure the aforementioned defects in Davis, Cooper, and Dyke. For instance, Yu fails to teach or suggest any type of carbon nanotube dispersion in any type of superacid solvent. In fact, Yu also fails to teach or suggest any type of carbon nanotube functionalization. For instance, independent word searches for "nanotube", "functionalize" and "functionalization" in Yu yielded no results. Applicants also traverse the aforementioned rejections for the reasons set forth in the Reply filed on July 9, 2010.

XVI. 35 U.S.C. §103(a) Rejection of Claims 1-5, 7-10, 12-13, 15-17, 19-20, 24, 28 and 30-32 over Bahr in view of Davis

The Examiner rejected claims 1-5, 7-10, 12-13, 15-17, 19-20, 24, 28 and 30-32 as allegedly being obvious over a 2001 Chem. Matter. article by Bahr et al. entitled "Highly Functionalized Carbon Nanotubes Using in Situ Generated Diazonium Compounds" (hereinafter "Bahr") in view of Davis. Office Action, pages 19-21. Applicants respectfully traverse these rejections because the combination of Bahr and Davis does not teach or suggest all the limitations of the rejected claims.

For instance, with respect to independent claim 1, the Combination of Bahr and Davis does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1. As set forth previously, Applicants are unaware of any disclosure in Davis that pertains to any methods for functionalizing carbon nanotubes in acid solvents (as defined in claim 1) by any added functionalizing agents. *See* Section X of Response.

The aforementioned defects in Davis are not surprising because Davis deviated from the goals and approaches of the present invention (as previously described). In particular, Davis merely focused on designing and optimizing a process for forming macroscopic objects for studying phase behavior and rheology of SWNTs. See, *e.g.*, Abstract. Thus, it is not clear how such phase behavior and rheology studies would have required the functionalization of carbon nanotubes dispersed in acid solvents by added functionalizing agents.

Furthermore, Bahr does not cure the aforementioned defects in Davis. For instance, as the Examiner admits, "Bahr does ***not*** disclose ***an acid solvent***, the carbon nanotubes having substantially exposed sidewalls, or the ***functionalizing*** comprising ***covalently*** attaching functional groups to the substantially exposed sidewalls." *See* Office Action, page 19 (paragraph 64) (emphasis added). Accordingly, it is not clear how Bahr could teach or suggest any methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1.

The aforementioned defects in Bahr are also not surprising because any acid treatment of carbon nanotubes in Bahr constituted stirring in hydrochloric acid, not dispersion in superacids and oxoacids further comprising a persulfate species, as currently required for claim 1. *See, e.g.,* page 3823 (col. 2). Furthermore, any subsequent functionalization steps after acid treatment in Bahr occurred after the acid-treated carbon nanotubes were "washed with ***copious*** amounts of water, then with 10% aqueous sodium bicarbonate, and finally with ***additional water.***" *Id.* (emphasis added). In fact, the aforementioned steps indicate that Bahr deviated from the claimed invention.

In the Office Action, the Examiner alleges that "it would have been obvious to one of ordinary skill in the art to modify the process of Bahr with the superacid of Davis in order to obtain a high concentration of dispersed carbon nanotubes." Office Action, pages 20-21 (paragraph 73). Applicants respectfully submit that such a mere conclusory statement does not establish a *prima facie* case of obviousness. Furthermore, in view of the aforementioned deviant approaches of Bahr and Davis, Applicants respectfully submit that the above-mentioned rejections are based on improper hindsight reasoning. This is affirmed by the fact that the authors in Davis did not have any desire or motivation to functionalize carbon nanotubes (as set forth in the Interview).

Dependent claims 2-5, 7-10, 12-13, 15 and 30 pertain to different variations of independent claim 1. Therefore, those claims are also not obvious over Bahr and Davis for at least the aforementioned reasons that independent claim 1 is not obvious.

Independent claim 16 is also not obvious because the combination of Bahr and Davis does not teach or suggest any methods of forming "diazonium species" in a "superacid solvent" and "reacting…single-wall carbon nanotubes with the diazonium species while" the carbon nanotubes are "dispersed in the superacid solvent to form functionalized single-wall carbon nanotubes", as required for claims 16. As set forth previously, Applicants are unaware of any disclosure in Davis that pertains to any methods for functionalizing carbon nanotubes in superacid solvents by any functionalizing agents, including formed diazonium species. *See* Section XIV of Response. Furthermore, Bahr does not cure the aforementioned defects in Davis, at least in view of the Examiner's admissions that "Bahr does ***not*** disclose ***an acid solvent***, the carbon nanotubes having substantially exposed sidewalls, or the ***functionalizing*** comprising

covalently attaching functional groups to the substantially exposed sidewalls." *See* Office Action, page 19 (paragraph 64) (emphasis added).

Dependent claims 17, 19-20, 24, 28 and 31-32 pertain to different variations of independent claim 16. Therefore, those claims are also not obvious over Bahr and Davis for at least the aforementioned reasons that independent claim 16 is not obvious.

XVII. 35 U.S.C. §103(a) Rejection of Claim 6 over Bahr, Davis and Niu

The Examiner rejected dependent claim 6 as allegedly being obvious over Bahr, in view Davis, and in further view of Niu. Office Action, pages 21-22. Applicants respectfully traverse this rejection because the combination of Bahr, Davis and Niu does not teach or suggest each and every limitation of dependent claim 6.

As set forth in Section XVI of this Response, the Combination of Bahr and Davis does not teach or suggest methods of functionalizing carbon nanotubes while the carbon nanotubes are dispersed in an acid solvent through the covalent attachment of added functionalizing agents to the dispersed carbon nanotube solution, as currently required for independent claim 1 (incorporating the limitations of cancelled claim 6). As also set forth previously, Niu does not cure the aforementioned defects in Davis and Bahr. *See* Section VI of Response. Rather, Niu teaches away from the claimed invention. *Id.*

XVIII. 35 U.S.C. §103(a) Rejection of Claim 21 over Bahr, Davis and Yu

The Examiner rejected dependent claim 21 as allegedly being obvious over Bahr, Davis and Yu. Office Action, page 22. Applicants respectfully traverse this rejection because the combination of Bahr, Davis and Yu does not teach or suggest each and every limitation of dependent claim 21.

For the reasons set forth previously, the combination of Bahr and Davis does not teach or suggest each and every limitation of dependent claim 21 (due to its dependency on independent claim 16). *See* Section XVI of Response. Furthermore, Yu does not cure the aforementioned defects in Bahr and Davis.

In fact, Yu fails to teach or suggest any type of carbon nanotube dispersion in any type of superacid solvent. Yu also fails to teach or suggest any type of carbon nanotube

functionalization. For instance, independent word searches for "nanotube", "functionalize" and "functionalization" in Yu yielded no results.

XIX. 35 U.S.C. §103(a) Rejection of Claim 29 over Bahr, Davis and Khabashesku

The Examiner rejected dependent claim 29 as allegedly being obvious over Bahr, in view Davis, and in further view of Khabashesku. Office Action, pages 22-23. Applicants respectfully traverse this rejection. For the reasons set forth previously, the combination of Davis and Bahr does not teach or suggest each and every limitation of dependent claim 29 (due to its dependency from independent claim 1). *See* Section XVI of Response. Furthermore, Khabashesku cannot cure any defects in Bahr and Davis because Khabashesku is not a prior art reference as a matter of law. *See* Section IX of Response.

XX. Double Patenting Rejections

In the Office Action, the Examiner rejected claims 1-2, 4-5, 7–10, 15-16, 20, 24 and 28 on the grounds of non-statutory obviousness-type double patenting as allegedly being unpatentable over claims 1–5, 11, 20 and 25 of commonly-owned U.S. Pat. No. 7,459,137 (hereinafter "the '137 patent"). Office Action pages 24-25. Applicants respectfully traverse these rejection for the reasons set forth in the Reply filed on July 9, 2010. Applicants also traverse these rejections because the above-mentioned claims in the '137 patent also fail the one-way obviousness test under M.P.E.P. §804 due to their silence on the functionalization of carbon nanotubes by added functionalizing agents while the carbon nanotubes are dispersed in superacids and/or acid solvents (as currently claimed). For the reasons set forth in this Response, the aforementioned claim limitations make the rejected claims patentably distinct from the claims of the '137 patent.

CONCLUSION

For at least the reasons stated above, Applicants assert that claims 1 –5 and 7-32 are in condition for allowance. Accordingly, Applicants respectfully request an allowance of the aforementioned claims. Applicants also request that the Examiner call Applicants' Attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining issues.

Respectfully submitted,
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